REPORT NO. M-CE-2035
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[redacted] DEVELOPMENT REPORT

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M-CE-2035

#2789 (add)

Metallurgical Project

A. H. Compton, Project Director

* * *

Clinton Laboratories

M. D. Whitaker, Director

R. L. Doan, Associate Director for Research

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ENGINEERING DEVELOPMENT SECTION

M. C. Leverett, Section Chief

SEMIMONTHLY REPORT FOR PERIOD ENDING SEPTEMBER 15, 1944

#2789 (add)

ENGINEERING DEVELOPMENT SECTION

M. C. Leverett, Section Chief

SEMIMONTHLY REPORT FOR PERIOD ENDING SEPTEMBER 15, 1944

Number	Title	Status	% Effort Expended This Period	% Effort Expended Next Per.
124-X1E	Radiation vs. Corrosion	Reduced Activity	17.7	30
147-X3E	X Stack Gas Disposal	Starting Runs	11.3	10
107-X5E	Operating Power Clinton Pile	Inactive	0	0
107-X6E	Increasing Pile Power	Minor Activity	1.4	0
124-X11E	Aluminum^{28} in Pile Water	Inactive	0	0
124-X12E	Corrosion Potentials	Inactive	0	1
141-X13E	Design of Shipping Containers	Minor Activity	0.5	0
124-X14E	Radiation vs. Film Formation	Revising Apparatus	4.5	5
107-X15E	New Pile Explorations	Report Tabled	1.2	1
227-X16E	Waste Uranium Recovery	Active	11.6	15
242-X17E	205 Stack Gas Monitoring	Active	3.3	2
122-X19E	Spray Cooling X Pile	Minor Activity	1.9	1
127-X20E	Detection Jacket Failure by Activity	Active	13.9	0
124-X21E	Detection of Blisters	Active	25.2	25
263-X60C	Ianthanum^{140}	Active	8.5	10
127-X18P	Bare Slug Water Activity	Inactive	0	0
102-X20P	Product/Power Ratio	Inactive	0	0
			100.0	100

*# Total technical personnal this period - 35
**# Total technical personnal next period - 33

* Including part time of Kline, Carlson and Simpson, Metallurgical Laboratory.
# Including full time of Bloch, Nierman, Murray, Saper, Schatz, Barton and Modine, Metallurgical Laboratory.
** Including part time of Kline, Metallurgical Laboratory.

Changes in Personnel

K. J. Sax and W. C. Overholt were transferred from the Semiworks and Process Development Division to the Engineering Development Section at the beginning of the report period. They have been assigned to work on the analysis of air for active xenon. S. Kuniansky was transferred to HEW at the beginning of the report period. The group formerly headed by him has been combined with R. B. Briggs' group.

Problem Assignment 124-XLE : Radiation vs. Corrosion (Bernstein, Carson, Briggs, McCullough, Croghan, Witkowski, Ura, Reid, Manowitz, Lore, Manowitz, Sigman, Feinberg, Winsch, part time)

The corrosion run in the W tubes at 50° (18-7) was stopped after 31 days of operation in order to make way for delayed neutron monitoring experiments. The run was made with synthetic W water of pH 7.5, 10 ppm added silica, and 0.05 ppm iron. Hanford Si-bonded slugs were used. No film appeared on the slugs and there was no pressure drop increase. Corrosion was less than .2 mil/mo. Water velocity was 6'/sec.

Run 19-6, the companion to this run, made at 85° is now 20 days old and is to be continued. No pressure drop increase and no evidence of jacket failure have been noticed. The iron content of the water used in these experimental runs is abnormally low. Tube #14 is being used for tests on the corrosion resistance of steel slugs coated with a special sodium-aluminum silicate. These slugs have not been removed from the tube as yet. Tests made outside the pile indicated rather poor corrosion resistance. Dr. L. F. Curtis who supplied the slugs under test has secured additional slugs coated with a similar but somewhat different material for testing also.

Tests made outside the pile to compare 2S and 72S corrosion in pile water have gone a total of 55 days. Oxalic acid washes have been applied periodically. The weight loss of the 2S has been nearly twice that of the 72S although both are within tolerable limits.

McCullough is still waiting on delivery of materials for construction of a circular saw for removing a stuck slug from the tubes. Lore reports that cold 70% nitric acid failed to remove a stuck slug in 24 hours. Hot nitric acid removed the slug in 13 hours. It is thus indicated that this method of removal is feasible although it may not be as convenient as the use of a chisel or saw.

Problem Assignment 147-X3E : X Stack Gas Disposal (Overholt, Kline, Sax, full time; Carson, Ward, Briggs, Lore, part time)

The apparatus to be used for determination of radio-xenon in the atmosphere has arrived and has been set up. It consists essentially of a trap filled with liquid air through which the sample is drawn and in which the higher boiling gases such as xenon and radon are condensed. This solution is then vaporized and the xenon and radon separated by selective adsorption. Preliminary tests on the apparatus indicate that it is in good working order and it is anticipated that both blank and active runs will be made during the coming period.

Problem Assignment 107-X5E : Operating Power Clinton Pile

Inactive.

Problem Assignment 107-X6E : Increasing Pile Power (Briggs, Sisman, part time)

Tests were conducted to determine whether X slugs would ignite in air at 300°C and 50-60 $^{\circ}$/sec. This information was requested in view of the recent increase in temperature in the pile to 250°. No ignition was noticed at this temperature although there was much oxidation of the slugs having broken jackets and of a piece of bare metal tested at the same time. Details are reported in M-CE-2025.

Problem Assignment 124-X11E : Aluminum^{28} in Pile Water

Inactive.

Problem Assignment 124-X12E : Corrosion Potentials

Inactive.

Problem Assignment 141-X13E : Design of Shipping Containers (Lore, part time)

Routine shop contacts were made to maintain progress on the manufacture of containers described in previous reports.

Problem Assignment 124-X14E : Radiation vs. Film Formation (Bernstein, Ura, Briggs, Manowitz, Witkowski, Feinberg, part time; Weil, full time)

The apparatus being used to determine the rate of film build-up in Al capillary tubes is being revised. It has been characterized by rather poor reproducibility and it now seems established that improved accuracy can be had only if measures are taken to prevent emergence of air from solution in the water during passage through the tube. This discovery does not effect the conclusions previously presented however.

Problem Assignment 107-X15E : New Pile Explorations (Weills, Lane)

A detailed report on the carbide power pile has been reviewed. It has been decided that completion of this report will be deferred until more time is available to work on this assignment.

A suggestion by C. D. Coryell and H. S. Brown that a homogeneous uranyl sulfate pile be built is being considered to the extent that suitable materials of construction are being sought.

Problem Assignment 227-X16E : Waste Uranium Recovery (Silverman, full time; Ward, Weills, Lane, Lore, part time)

Weills has completed a calculation of the activities to be expected in W-10 and W-7 at various times during the coming five years. The calculations show that the largest gamma contributor is the zirconium-columbium duo at present. After the end of 1945, cesium^{135} will be the largest gamma contributor. Strontium, yttrium, cerium and praseodymium are the main present beta sources. After the end of 1945, cerium and praseodymium will be the main ones. These calculations are based on a detailed analysis of operating data which includes time exposed in pile, power during exposure, and cooling time.

Silverman is making a laboratory study to determine the effectiveness of removal of phosphate ion by precipitation of uranium peroxide. This is a possibly important point since some of the uranium phosphates apparently tend to precipitate during solvent extraction if the phosphate is not previously removed. Other experiments with packed glass columns show that Berl saddles and Raschig rings are definitely superior to Fenske rings and beads from the point of view of permissible liquid velocity without flooding.

In general, three procedures for solvent recovery of uranium are now under consideration.

1. Acidification, precipitation of insolubles with calcium nitrate followed by extraction with dibutyl carbitol.

2. Acidification, precipitation of barium insolubles and extraction as above.

3. Acidification, precipitation of uranium peroxide, re-solution of the precipitate in nitric acid, and extraction of this solution with dibutyl carbitol.

The third procedure, although requiring handling relatively large precipitates, now seems the most attractive of the three.

Recent reduction in manpower in the Analytical Division has considerably slowed down progress on this problem since all chemical analyses have been performed by the Analytical Division.

Problem Assignment 242-X17E : 205 Stack Gas Monitoring (Adams, full time; Briggs, part time)

Numerous small adjustments and substitutes of more suitable types of equipment have been made in the analytical setup in Building 204 with which it is intended to determine the xenon and iodine activities in dissolver off gases. Many of the difficulties with this equipment have arisen from the fact that it was originally designed for somewhat difference service and is not suitable without extensive alterations for the present purpose. The new equipment includes a new bellows in the Taylor flow control, steam reducing valve on the steam jets, liquid traps on all lines to prevent access of liquid HNO_3 to the ring balances and other instruments.

Problem Assignment 242-X19E : Spray Cooling X Pile (Briggs, Sisman)

Investigation of stable fogs for introduction into the inlet duct of the X pile indicates that such fogs probably contain too little liquid water perceptibly to increase the pile power. It is now suggested that the water might be introduced as a very thin high velocity jet into each tube in the pile. It is reasoned that the momentum of the jet will carry the water to the hot portions of the pile where it will evaporate rather than saturate the graphite. It is likely that this proposal will be tried.

Problem Assignment 127-X20E : Detection of Jacket Failure by Activity (Carlson, Simpson, full time; Bernstein, Briggs, Witkowski, Reid, Manowitz, Ura, Winsch, Feinberg, part time)

Carlson and Simpson returned near the beginning of the report period to continue work on the delayed neutron method for detection of burst jackets. The data obtained are not completely understood.

The apparatus consisted essentially of a neutron counting chamber strapped to a pipe through which water from the pile was passed. Provisions for various delay times were incorporated in the apparatus. The neutron chamber was shielded with paraffin, cadmium and masonite so that there was no interference from the neutron field in the room. It was found that a considerable counting rate persisted even when the pile had been shut down, after water had been passed through it and through the pipe to which the counting chamber was strapped. This counting rate was much less when no sodium dichromate was added to the water and could be reduced to background by washing the pipe with oxalic acid. It has been suggested that the counts observed are due to emission of delayed neutrons by some product originating from bombardment of chromium, but the final analysis of the data is yet to be made. It was also found that practically all kinds of slugs and tubes contain enough uranium on the surface at least to cause a neutron count which would indicate a considerable exposure of bare metal. This appeared to be no worse with badly penetrated slugs than non-penetrated or dummy slugs. Carlson and Simpson have returned to Chicago for study of the data.

Problem Assignment 128-X21E : Detection of Blisters (Block, Murray, Saper, Nierman, Schatz, Modine, Barton, Gordon, full time; Briggs, McCullough, Croghan, Manowitz, part time)

The group of physicists working in Building 305 report that electrical transducers are now available so that experiments on the transmission of sound through the annulus between tube and slugs can be undertaken. It is still thought to be impractical to listen for blister-produced changes in tube noises since the noise itself is variable and unreproducible. At best, blisters produce only extremely slight changes. There is some reason to believe that frequencies between 150 and 600 kc can get through the annulus. There is as yet, however, no indication of the effect of a blister on transmission.

Gordon and McCullough continued to experiment with the electrical methods for determining a contact between slug and tube. One of the principal difficulties lies in the fact that blisters cannot be produced at will. No definite results are yet available, but the outlook is favorable. Glass cloth and thread are now being considered as insulators for the slugs. Samples are under bombardment in the pile to determine the effect on mechanical properties.

Problem Assignment 263-X60C : Lanthanum^{140} (Webster, White, full time; Ward, McCullough, Lore, part time)

Operation of the apparatus for preparation of La^{140} has started. It seems to be going in a generally satisfactory way. White has spent full time in preparation of drawings for the report which will be issued covering this preparation. McCullough has undertaken the design of a new and presumably more permanent installation for this preparation. The principal changes from the present design are that it is planned to use batches of 50 slugs rather than 12 slugs each, also, centrifuging will be substituted for filtering wherever possible, and that no glass or other fragile materials will be used in the irradiated regions. It is clear also that such an apparatus cannot be set up in the present cells in Building 706C because of their small size. It is not, however, known what building facilities will be required as yet. The design is being done on an "if-as-and-when" basis inasmuch as it has not been decided that such apparatus will be built.

Problem Assignment 127-X18P : Bare Slug Water Activity

Inactive.

Problem Assignment 102-X20P : Product/Power Ratio

Inactive.

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Metallurgical Project

A. H. Compton, Project Director

* * *

Clinton Laboratories

M. D. Whitaker, Director

R. L. Doan, Associate Director for Research

* * *

ENGINEERING DEVELOPMENT SECTION

M. C. Leverett, Section Chief

SEMIMONTHLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1944

[redacted]

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ENGINEERING DEVELOPMENT SECTION

M. C. Leverett, Section Chief

SEMIMONTHLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1944

Number	Title	Status	% Effort Expended This Per.	Next Per.
124-X1E	Radiation vs. Corrosion	Active	22	20
147-X3E	X Stack Gas Disposal	Active*	9	10
107-X5E	Operating Power Clinton Pile	Inactive	0	0
107-X6E	Increasing Pile Power	Inactive	0	0
124-X11E	Aluminum^{28} in Pile Water	Inactive	0	0
124-X12E	Corrosion Potentials	Minor Activity	2	2
141-X13E	Design of Shipping Containers	Inactive	0	3
124-X14E	Radiation vs. Film Formation	Active	6	5
107-X15E	New Pile Explorations	Inactive	0	0
227-X16E	Waste Uranium Recovery	Active	15	15
242-X17E	205 Stack Gas Monitoring	Active	5	3
122-X19E	Spray Cooling X Pile	Minor Activity	2	2
127-X20E	Detection Jacket Failure by Activity	Inactive	0	0
124-X21E	Detection of Blisters	Active*	30	30
263-X60C	Lanthanum^{140}	Active	8	8
127-X18P	Bare Slug Water Activity	Starting again	1	2
102-X20P	Product/Power Ratio	Inactive	0	0
			100	100

*Total technical personnel this period = 33
*Total technical personnel next period = 31

Including all or part time of Moon, Saper, Nierman, Block, Murray, Modine, Schaatz, Barton and Kline, Metallurgical Laboratory.

Changes in Personnel

J. A. Lane was transferred from this laboratory during the period. B. E. Phillips was added to the Corrosion Group, transferring from 100 Area Operations. S. A. Kline of the Metallurgical Laboratory returned to that Laboratory after superintending setting up and initial runs of the xenon analysis apparatus.

Problem Assignment 124-X1E : Radiation vs. Corrosion (Winsch, Feinberg, full time; Briggs, Reid, Witkowski, Ura, Phillips, Manowitz, Bernstein, Carson, part time)

There were no significant developments on this problem during the half month just passed. A charge of Hanford silicon-bonded slugs has gone 39 days at 85° in W water without evidence of failure. Experiments also are being conducted to determine the suitability of a coating consisting of a special sodium-aluminum silicate compound in which Dr. L. F. Curtis is interested. Tests on steel slugs coated with this material were terminated after 25 days. The slugs were observed to have rust spots on them, but Dr. Curtis expressed optimism since he felt that the coating as applied was much poorer than could be attained. Tuballoy slugs coated with this material are to be supplied by Dr. Curtis for further testing.

Problem Assignment 147-X3E : X Stack Gas Disposal (Sax, Overholt, full time; Briggs, Kline, Carson, part time)

The apparatus for determination of radio-xenon in the atmosphere near the plant has been operated three times. The first run was presumably a blank run and the sample taken during a period when there was no dissolving going on in Building 205. A count of 50 c/min due to radio-xenon was observed. The two active runs taken during periods of dissolving and at locations where it was hoped that maximum concentrations of xenon would be found have given 70 and about 200 c/min. These results have not been calibrated in terms of xenon content of the air, but counts due to radon in the same apparatus have run more than 1000 c/min on occasion. It is, therefore likely that xenon concentration is extremely small. Additional runs will be made as dissolvings permit.

Problem Assignment 107-X6E : Increasing Pile Power

Inactive.

Problem Assignment 124-X11E : Aluminum^{28} in Pile Water

Inactive.

Problem Assignment 124-X12E : Corrosion Potentials (Briggs, Bernstein, White, part time)

Data were worked up for a report.

Problem Assignment 141-X13E : Design of Shipping Containers

Inactive.

Problem Assignment 124-X14E : Radiation vs. Film Formation (Weil, full time; Briggs, Reid, Witkowski, Phillips, Ura, Manowitz, Carson, part time)

A run in the capillary tube in the pile made with demineralized water containing 2 ppm sodium dichromate at pH 6.5 has shown no increase in pressure drop in 205 hours. This is thought possibly to be due to the fact that the iron content of the water is low.

Problem Assignment 107-X15E : New Pile Explorations

Inactive.

Problem Assignment 227-X16E : Waste Uranium Recovery (Lane, Weills, Silverman full time; Ward, White, part time)

During the period past, a meeting was held in New York with the District offices to discuss the recovery of waste uranium. The principal points developed were that recovery of the metal is a B problem and should not occupy the attention of more than 5% of the chemists. For most effective utilization, the material at Clinton should all be recovered by February 1946. Some stress was put on the fact that the recovery of Clinton metal can serve as a pilot plant for recovery of Hanford metal. In addition, the availability of dibutyl carbitol was discussed and it was developed that this material costs approximately 90¢/lb and is not in commercial production at present. The distribution coefficients of some of the elements which are by-products were stated to be of the order of 10^{-2} or less with the exception of columbium on which there is no data.

The experimental work on waste uranium recovery is being transferred from the Design Group to Section I of the Technical Division and will be supervised by W. H. Baldwin. The Design Group will continue to make studies of an engineering sort on the process.

Experimental work during the period past has shown that the presence of excess nitric acid in the waste solution does not markedly interfere with extraction of the waste by carbitol and removal of the uranium from the carbitol with water. Other work has shown that the separation of phosphate from uranium by precipitation of uranium peroxide is not effective and that uranium phosphate as well as uranium peroxide precipitates. This seems to rule out the proposal to effect the separation in this way. Other data, however, indicate that although there is considerable interference of phosphate ion with the transfer of uranium from the waste solution to the carbitol the transfer can nevertheless be effected. The data taken on small columns indicate that a column 15-26' tall should extract 99% of the uranium from the waste assuming that 600-400 grams/liter of calcium nitrate have been added to the waste. Other results of the column experiments show that the height of a transfer unit is about 3.6' for 1/4" saddles and about 4.6' and 6.5' respectively for flow rates of 20 and 40 cc/min in a 3/4" column with 1/4" rings. These values are in reasonably good agreement with those which would be predicted from the literature. During the period to come, emphasis will be placed on obtaining the still missing equilibrium data for the transfer of uranium from the waste to carbitol and from carbitol to water. The distribution of activities will also be sought. Three stainless steel columns are being set up in the Semiworks area for further small scale studies of this type.

Problem Assignment 242-X17E : 205 Stack Gas Monitoring (Adams, full time; Briggs, Witkowski, Ura, part time)

Satisfactory operation of the monitoring equipment in Building 204 was achieved during the period past. However, it is also desired to make some final alterations in the equipment before releasing it permanently. It is anticipated that this will be completed during the coming period.

Problem Assignment 122-X19E : Spray Cooling X Pile (Sisman, Briggs, part time)

A new nozzle will be used to introduce a jet of water into a channel in the pile, it being hoped that the stream will carry to the active portion of the pile. Additional calculations and research indicate that the amount of water which can be introduced by suspension in the main air supply could result in a power increase of only 5-600 KW maximum. This substantially checks the results report by Rupp some months ago.

Problem Assignment 127-X20E : Detection of Jacket Failure by Activity.

Inactive.

Problem Assignment 124-X21E : Detection of Blisters (Croghan, Murray, Modine, Block, Nierman, Saper, Schaatz, Barton, full time; Manowitz, Ward, McCullough, Gordon, Moon, part time)

McCullough and Gordon have continued experiments on a low priority level with the electric contactor type of blister detection. The feasibility of using glass cloth to insulate the slugs from the ribs has been partly investigated by exposing some of the cloth to radiation in the pile. After approximately seven days exposure, there was noticeable discoloration and it was indicated that the cloth had lost some of its strength. It is not yet established whether these are sufficiently unfavorable indications to rule out this material.

Work continues in Building 305 on the sonic detection of blisters. The equipment for high frequency sound transmission has finally been assembled. Two piezo-electric transducers and mounts have been received. The transducers which resonate at 725 kc and can be used at frequencies as high as 2000 kc have annular crystals of ammonium dihydrogen phosphate. It has been found that in an unloaded tube with water flowing, a signal of 10,000 times the noise level can be transmitted from the outlet end to the inlet end. Measurements in loaded tubes are at present under way.

Barton has designed lucite windows for installation at the ends of the nozzles and with the aid of these, it is found that some of the SMX tubes contain persistent air bubbles which cling to the tops of the tubes even at high pressure and flow rates. The lucite windows also permitted the incidental investigation of propagation of light through the annulus. It was found that in a clean tube loaded with clean slugs the light from a two-cell flashlight was readily visible through the annulus when water

was flowing. The light wa[redacted] When the water was cut off, the light immediately disappeared. After about three minutes, it was again faintly visible and after about half an hour, it was as bright as when the water was flowing. If the water were turned on again at any time during this half hour, maximum visibility was immediately restored. It is thought that these effects are due to suspended matter in the water. It was also observed that all but one of the standard orifices used at the inlet end of the tube gave rise to clouds of bubles at the input end.

A blistered slug was inserted and there was some indication that the distribution of light around the annulus was altered by the blisters. The blisters seemed to effect the transmission of a columnate light from a spot light more than the transmission of the light from a flood light. Several photographs were made without a lense which seemed to show that the blisters cast a shadow down the annulus.

Problem Assignment 263-X60C : Lanthanum^{140} (Webster, full time; Ward, McCullough, Gordon, part time)

After the successful operation of the equipment for the preparation of La^{140}, D. S. Webster has withdrawn from active participation in further preparations and has spent the period past in preparation of a report on the engineering phases of the installation. In addition, McCullough is working on the design of a more permanent type of installation for this same preparation. The principal differences between this and the present installation are to be the substitution of non-fragile materials such as stainless steel for glass wherever possible, the elimination of filters where this is possible and the substitution of centrifuges, and an increase in the size of the batch which may be processed.

Problem Assignment 127-X18P : Bare Slug Water Activity (Sisman, Briggs)

This assignment which has been inactive for some time has been reopened in order to complete it and to provide a final answer on the feasibility of the use of bare slugs at Hanford in a great emergency. Measurements during this period consisted only of determination of the electrochemical potential differences between tuballoy and aluminum and zinc. It is found that under operating conditions, the tuballoy will be protected from corrosion by either zinc or aluminum. It is probable that short bare slugs will be inserted in the pile during the coming period.

Problem Assignment 102-X20P : Product/Power Ratio

Inactive. [redacted]